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Zhevelev et al.

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(54) **MOTION DETECTION SYSTEMS AND METHODOLOGIES**

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(73) Assignee: **Tyco Fire & Security GmbH**, Neuhausen am Rheinfall (CH)

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CPC ***G01J 5/34*** (2013.01); ***G08B 13/191*** (2013.01)

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CPC G01J 5/08; G01J 5/0806; G01J 5/0846; G01J 5/14; G01J 5/34; G01J 5/60; G08B 13/191
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See application file for complete search history.

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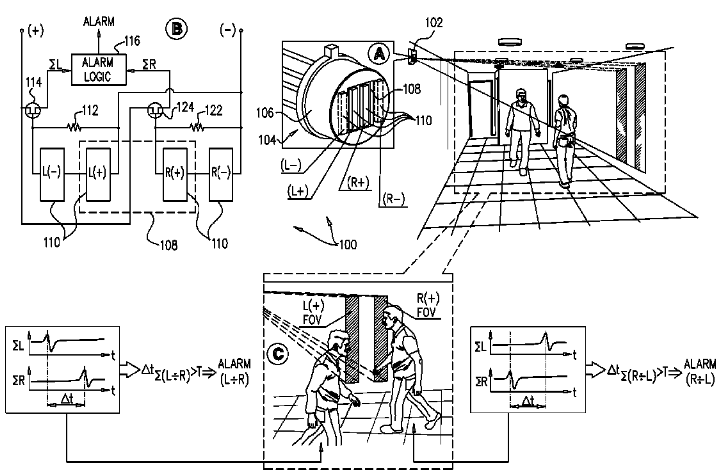
(57) **ABSTRACT**

A motion detector system including first and second pairs of pyro-electric elements, electrical interconnections between the pyro-electric elements in the first pair providing a first signal output and local temperature compensation for the elements in the first pair, electrical interconnections between the elements in the second pair providing a second signal output and local temperature compensation for the pyro-electric elements in the second pair, wherein the compensation for the first pair is independent of the compensation for the second pair, a housing enclosing the two pairs of pyro-electric elements and defining a window, only one of the pyro-electric elements in each pair viewing a motion detection field of view through the window, and a signal processor receiving the first and second signal outputs and providing an output indication of crossing the field of view by an object having a temperature different from the ambient in the field of view.

23 Claims, 9 Drawing Sheets



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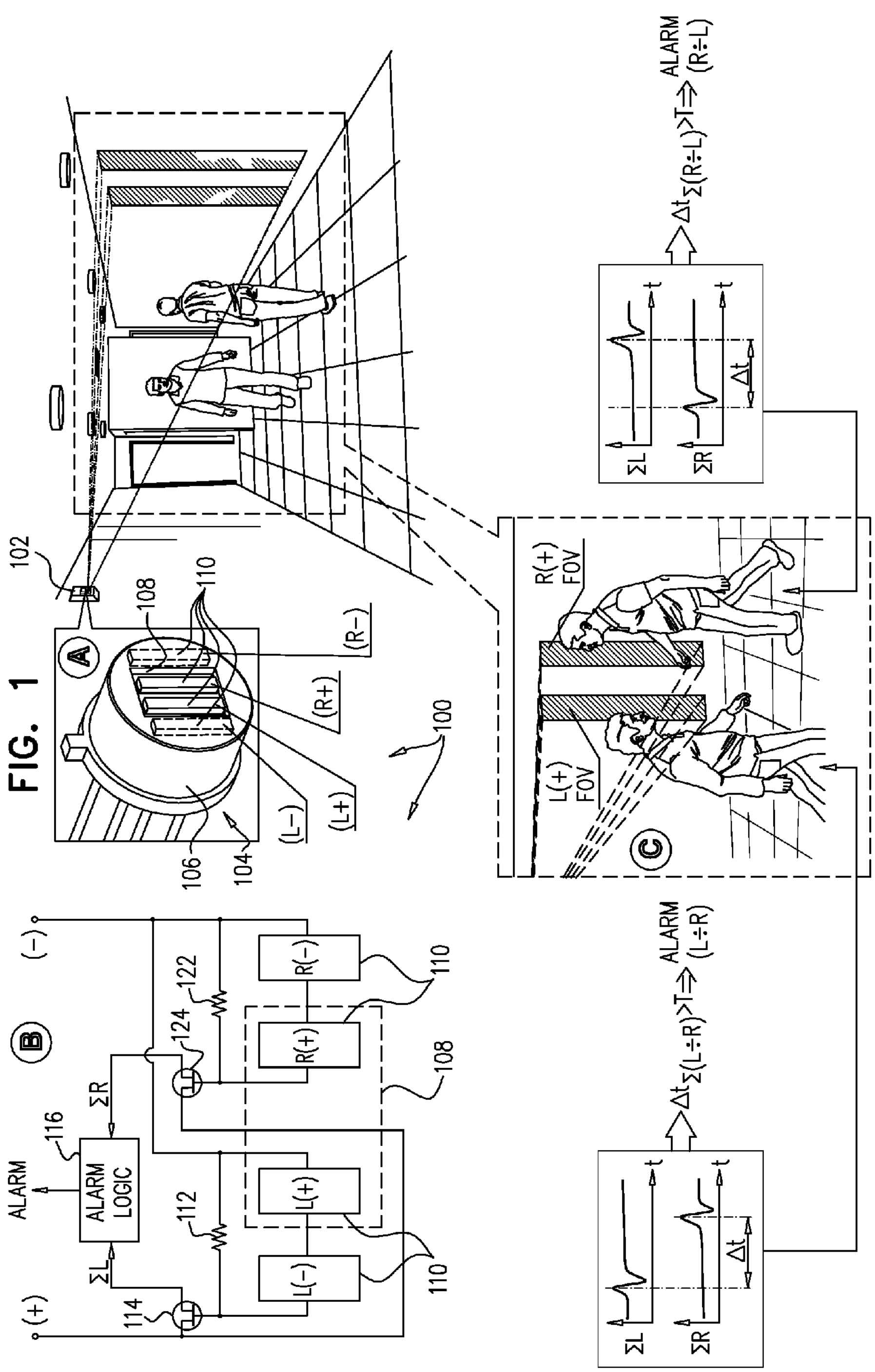
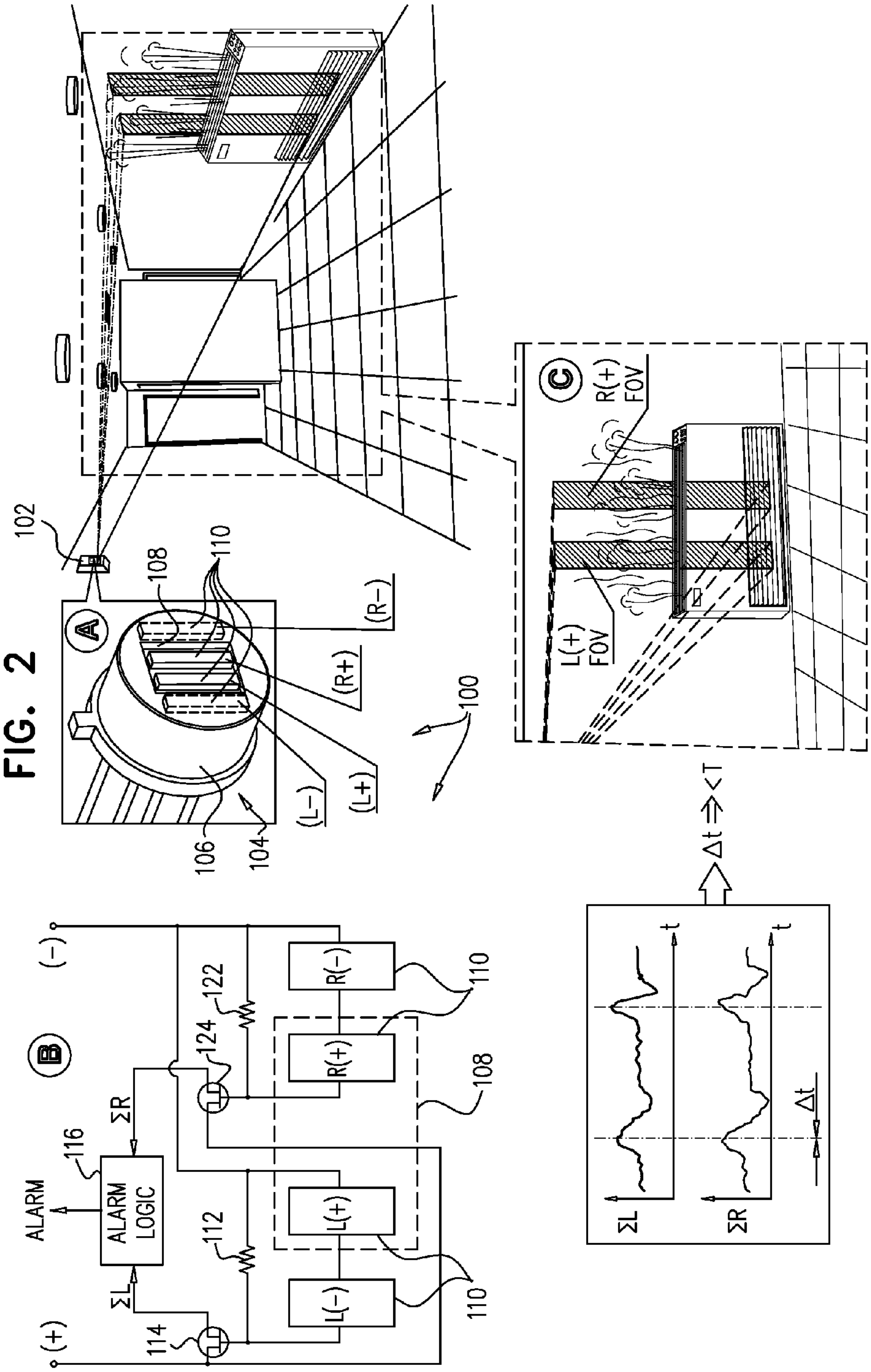


FIG. 1
A
B
C
100
102
104
106
108
110
112
114
116
122
124
(L−)
(L+)
(R+)
(R−)
ALARM
ALARM LOGIC
ΣL
ΣR
(+)
(−)
L(−)
L(+)
R(+)
R(−)
L(+) FOV
R(+) FOV
Δt
t
$\Delta t_{\Sigma(L \div R)} > T \Rightarrow$ ALARM (L÷R)
$\Delta t_{\Sigma(R \div L)} > T \Rightarrow$ ALARM (R÷L)


A
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100
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104
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108
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112
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122
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(L+)
(R+)
(R−)
L(+) FOV
R(+) FOV
ALARM
ALARM LOGIC
ΣL
ΣR
L(−)
L(+)
R(+)
R(−)
(+)
(−)
t
Δt
Δt ⇒ <T

FIG. 2

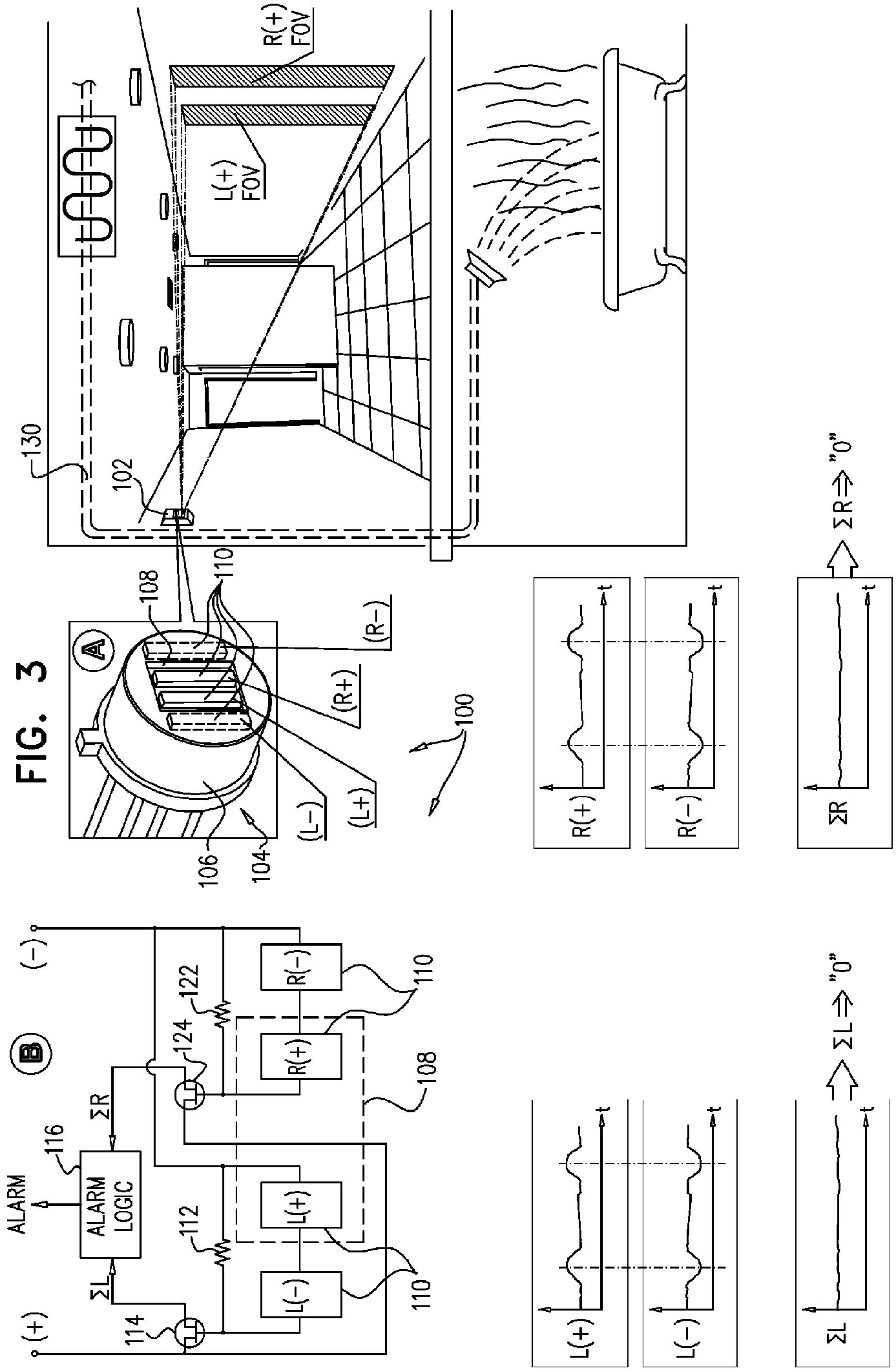

A
B
100
102
104
106
108
110
112
114
116
122
124
130
L(+) FOV
R(+) FOV
(L−)
(L+)
(R+)
(R−)
ALARM
ALARM LOGIC
ΣL
ΣR
(+)
(−)
L(+)
L(−)
R(+)
R(−)
t
ΣL ⇒ "0"
ΣR ⇒ "0"

FIG. 3

FIG. 4

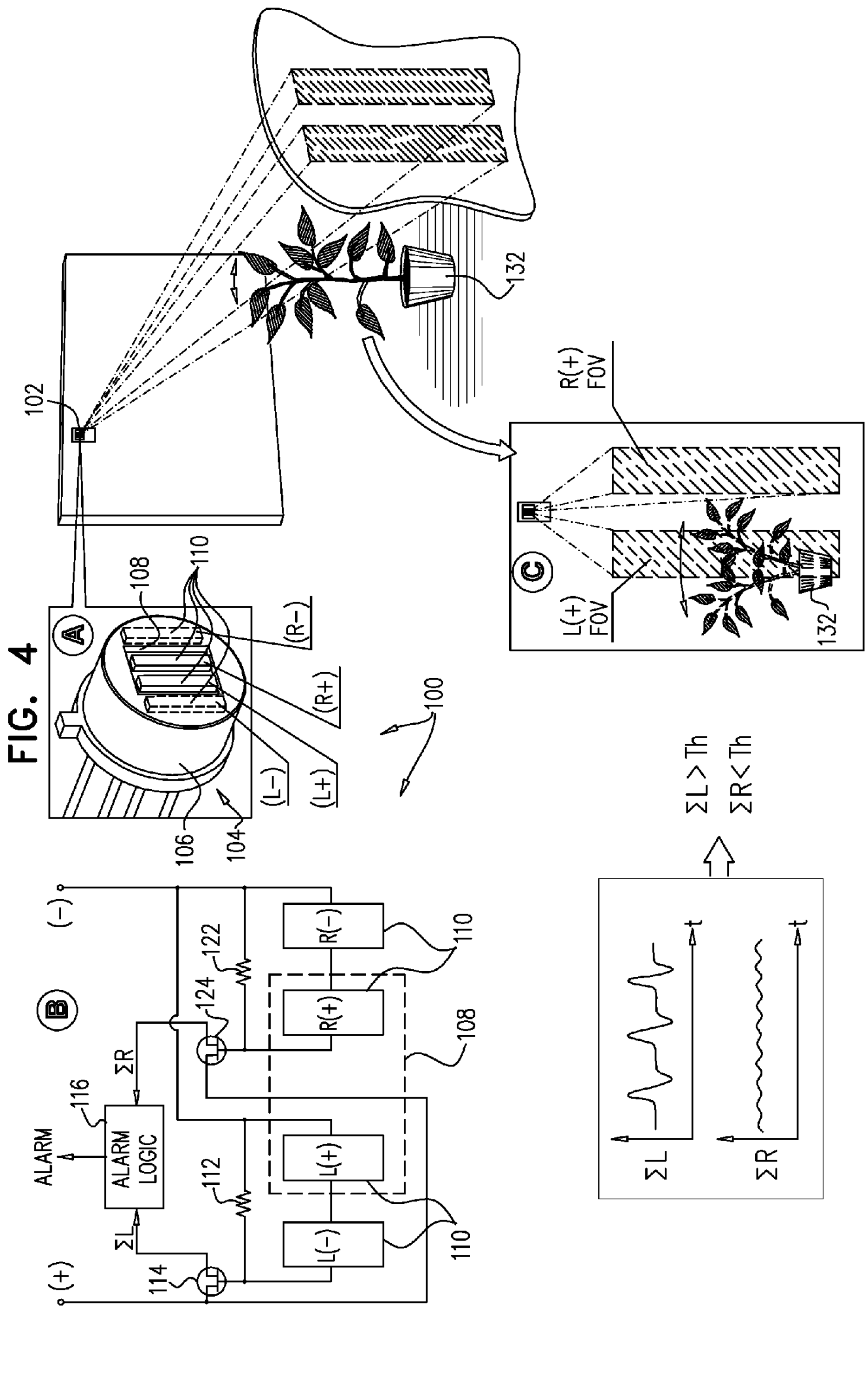
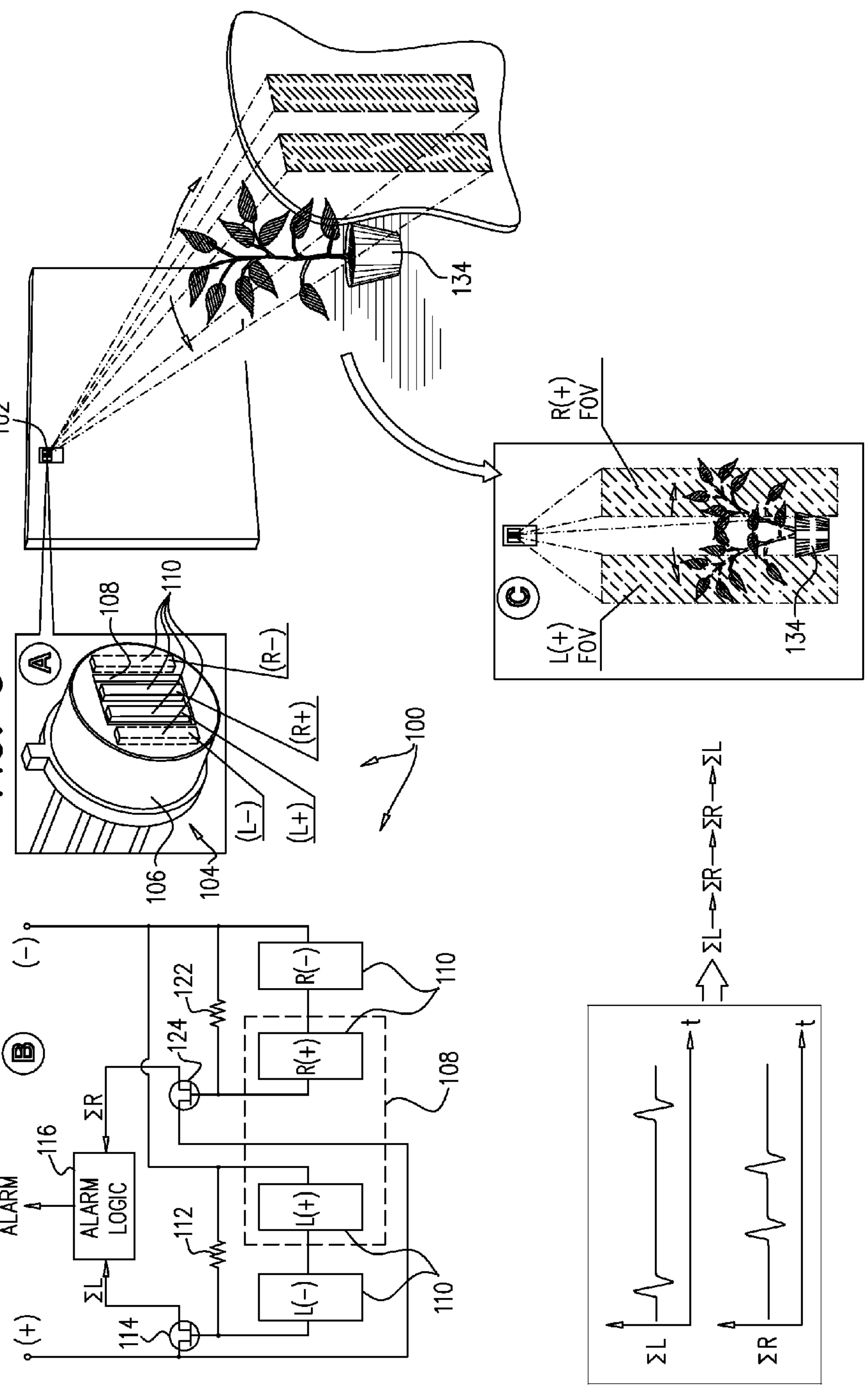
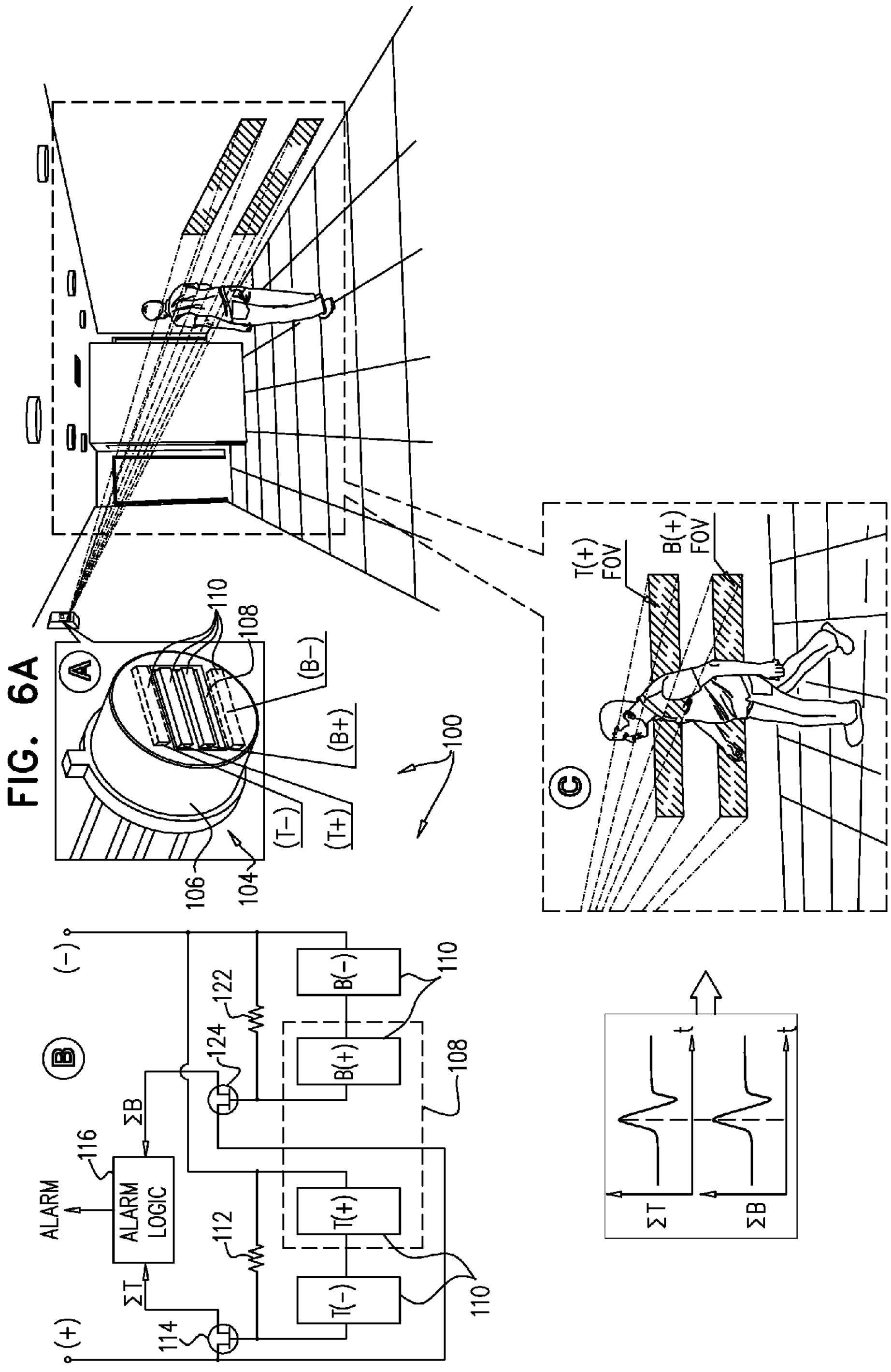

102
132
R(+)
FOV
L(+)
FOV
C
A
108
110
(R−)
(R+)
(L−)
(L+)
106
104
100
B
ALARM
ALARM LOGIC
116
ΣR
ΣL
124
122
112
114
(+)
(−)
R(−)
R(+)
L(+)
L(−)
ΣL > Th
ΣR < Th
t

FIG. 5



A
108
110
(R−)
(R+)
(L−)
(L+)
106
104
100
102
134
C
R(+)
FOV
L(+)
FOV
134
B
(+)
(−)
ALARM
ALARM LOGIC
116
ΣR
ΣL
114
112
122
124
L(−)
L(+)
R(+)
R(−)
108
110
110
ΣL
ΣR
t
t
ΣL→ΣR→ΣR→ΣL

FIG. 6A


A
B
C
110
108
(B−)
(B+)
(T−)
(T+)
106
104
100
T(+)
FOV
B(+)
FOV
ALARM
ALARM
LOGIC
116
ΣB
ΣT
114
112
122
124
T(−)
T(+)
B(+)
B(−)
(+)
(−)
t

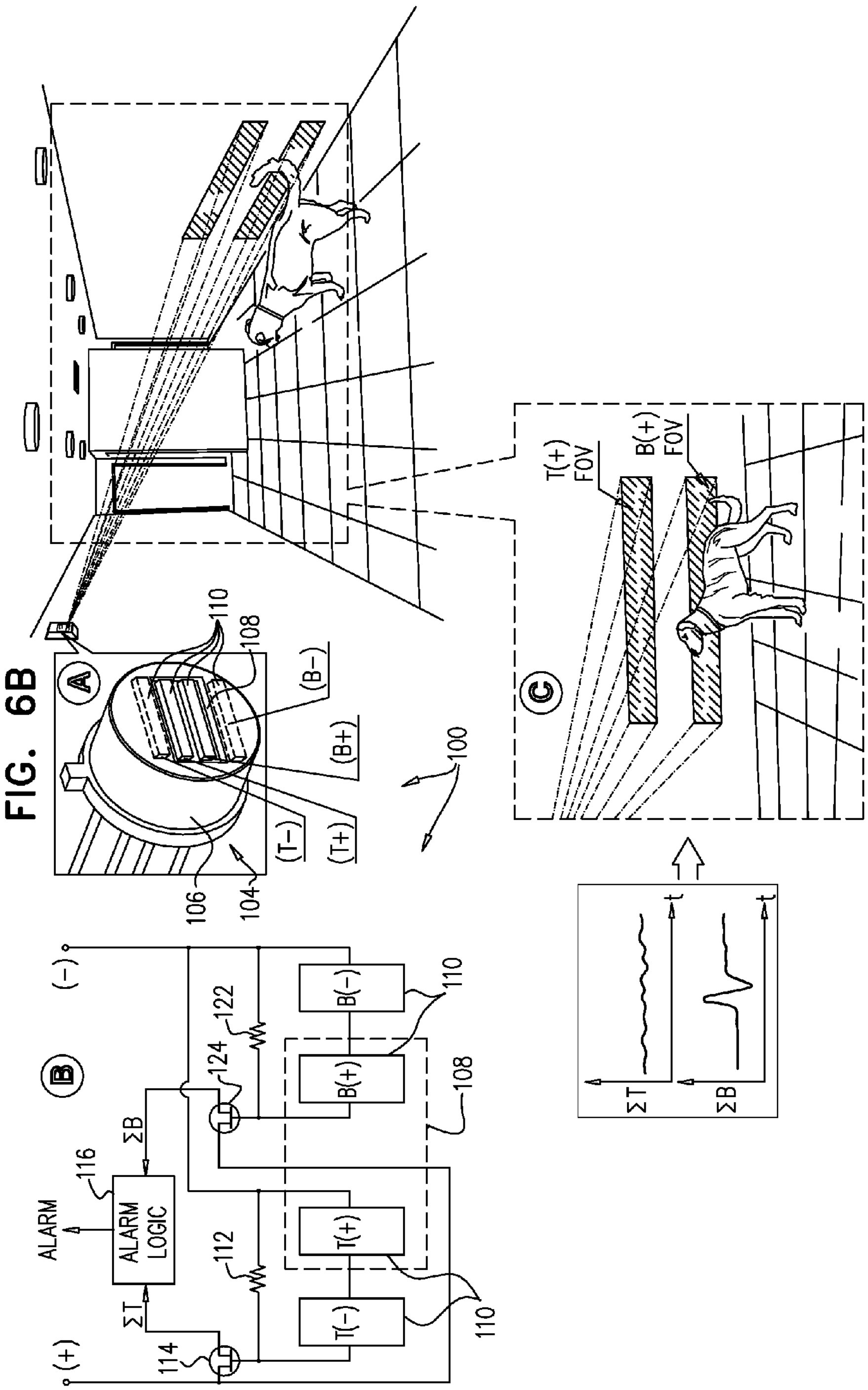

A
110
108
(B–)
(B+)
(T–)
(T+)
106
104
100
T(+) FOV
B(+) FOV
C
B
(+)
(–)
ALARM
ALARM LOGIC
116
ΣB
ΣT
124
122
114
112
T(–)
T(+)
B(+)
B(–)
t

FIG. 6B

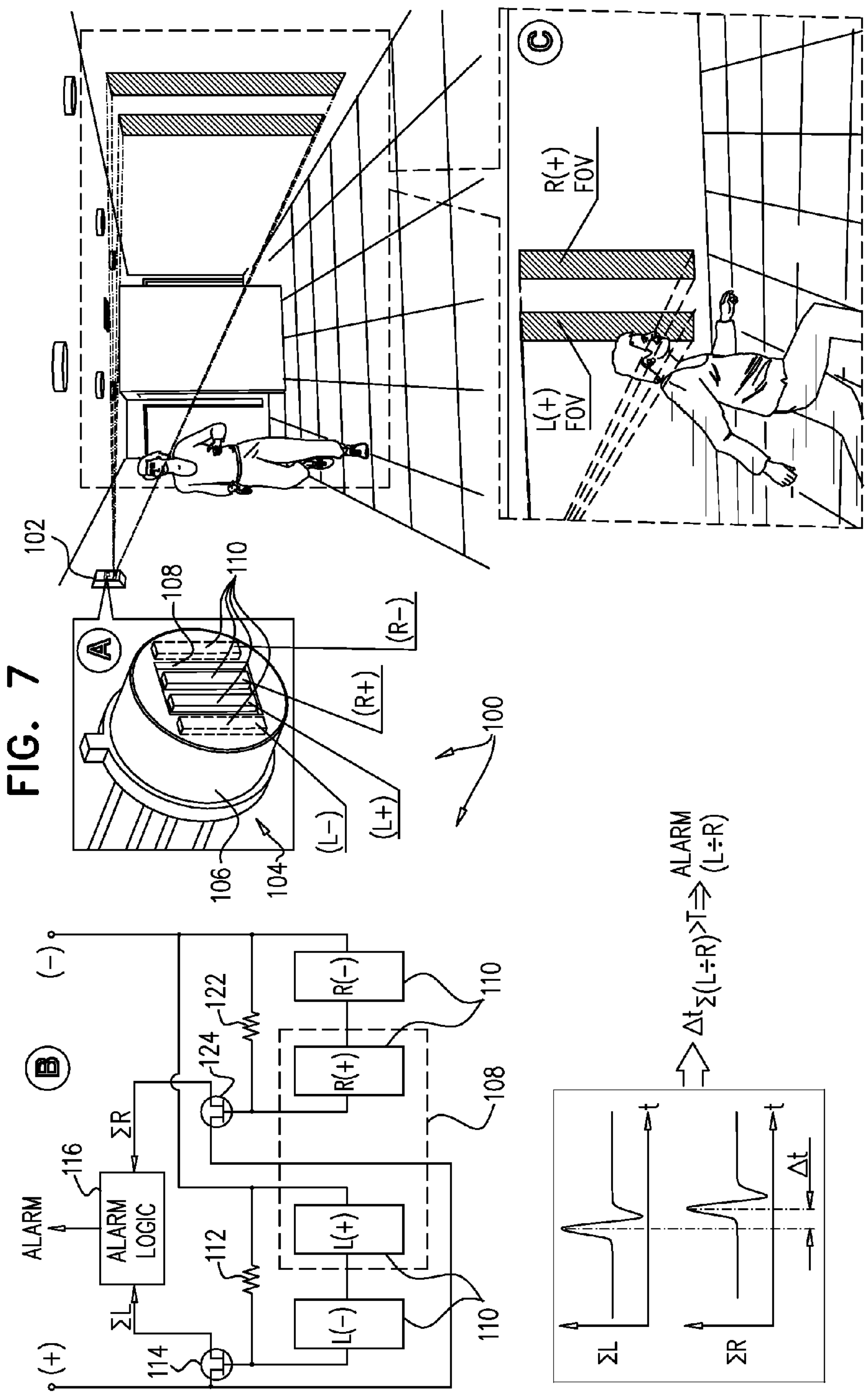

A
B
C
100
102
104
106
108
110
112
114
116
122
124
(L−)
(L+)
(R+)
(R−)
L(+) FOV
R(+) FOV
ALARM
ALARM LOGIC
ΣL
ΣR
(+)
(−)
L(−)
L(+)
R(+)
R(−)
t
Δt
$\Delta t_{\Sigma(L \div R)} > T \Rightarrow$ ALARM (L÷R)

FIG. 7

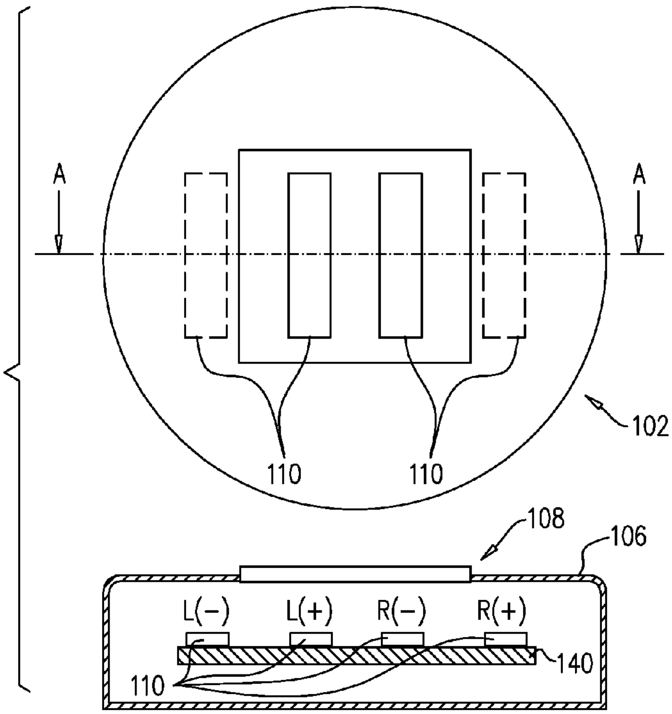

A
A
110
110
102
108
106
L(−)
L(+)
R(−)
R(+)
140
110

FIG. 8A

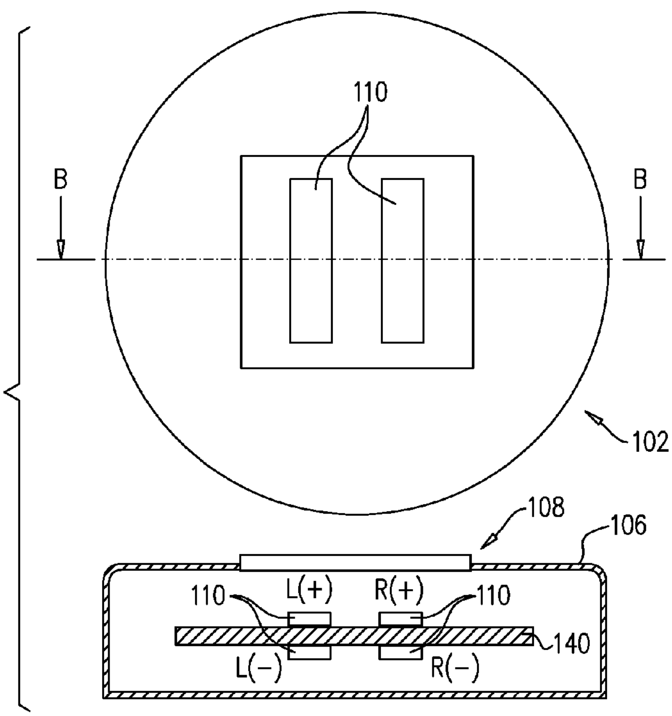

110
B
B
102
108
106
110
L(+)
R(+)
110
140
L(−)
R(−)

FIG. 8B

MOTION DETECTION SYSTEMS AND METHODOLOGIES

REFERENCE TO RELATED APPLICATIONS

The present application is related to the U.S. Provisional Patent Application Ser. No. 61/560,354, filed on Nov. 16, 2011 and entitled "QUAD ELEMENT, SEPARATED OUTPUT, PARTIALLY CONCEALED PYRO SENSOR", the disclosure of which is hereby incorporated by reference and priority of which is hereby claims pursuant to 37 CFR 1.78(a) (4) and (5)(i).

FIELD OF THE INVENTION

The present invention relates to motion detection systems generally and more particularly to novel motion detection systems incorporating pyro-electric sensors and to novel pyro-electric sensors useful therein.

BACKGROUND OF THE INVENTION

Various types of motion detection systems are known and are in widespread use. These include, inter alia, systems developed and manufactured by Visonic Ltd. and its successor company Tyco International, Inc.

SUMMARY OF THE INVENTION

The present invention seeks to provide improved motion detection systems and methodologies. There is thus provided in accordance with a preferred embodiment of the present invention a motion detector system including at least first and second pairs of pyro-electric elements, electrical interconnections between the pyro-electric elements in the first pair of pyro-electric elements providing a first signal output and local temperature compensation for the two pyro-electric elements in the first pair, electrical interconnections between the pyro-electric elements in the second pair of pyro-electric elements providing a second signal output and local temperature compensation for the two pyro-electric elements in the second pair, wherein the local temperature compensation for the two pyro-electric elements in the first pair is independent of the local temperature compensation for the two pyro-electric elements in the second pair, a housing enclosing the at least first and second pairs of pyro-electric elements and defining a window, only one of the pyro-electric elements in the first pair and only one of the pyro-electric elements in the second pair viewing a motion detection field of view through the window, and a signal processor electrically receiving the first signal output and the second signal output and providing an output indication of crossing the field of view by an object having a temperature different from the ambient in the field of view.

Preferably, the signal processor is operative to provide detection of crossing the field of view by an object at an angular velocity of between 1 and 2 degrees per second. Preferably, the signal processor is operative to disregard repeated crossing of the field of view in opposite directions by an object at an angular velocity less than 0.5 degrees per second.

In accordance with a preferred embodiment of the present invention, the signal processor provides an output indication of direction of crossing the field of view by an object having a temperature different from the ambient in the field of view.

Additionally or alternatively, the signal processor provides an alarm output indication in respect of crossing the field of

view by an object having a temperature different from the ambient in the field of view in a first general direction and not in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view in a second general direction opposite to the first general direction.

Additionally or alternatively, the signal processor provides a first output indication in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view in a first general direction and a second output indication in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view in a second general direction opposite to the first general direction.

Additionally or alternatively, the signal processor provides an alarm output indication in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view and not in respect of a stationary object having a temperature different from the ambient in the field of view.

Additionally or alternatively, the signal processor provides an alarm output indication in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view and not in respect of a stationary object outside of the field of view having a temperature different from the ambient in the field of view.

Additionally or alternatively, the signal processor provides an alarm output indication in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view and not in respect of repeated back-and-forth crossings of the field of view by an object having a temperature different from the ambient in said field of view.

Additionally or alternatively, the signal processor provides an alarm output indication in respect of crossing the field of view by a human and not in respect of crossing the field of view by a pet.

There is also provided in accordance with another preferred embodiment of the present invention a method for detecting motion, the method including electrically interconnecting between the pyro-electric elements of a first pair of pyro-electric elements, providing a first signal output and local temperature compensation for the two pyro-electric elements in the first pair, electrically interconnecting between the pyro-electric elements of a second pair of pyro-electric elements, providing a second signal output and local temperature compensation for the two pyro-electric elements in the second pair, wherein the local temperature compensation for the two pyro-electric elements in the first pair is independent of the local temperature compensation for the two pyro-electric elements in the second pair, enclosing the at least first and second pairs of pyro-electric elements and defining a window, only one of the pyro-electric elements in the first pair and only one of the pyro-electric elements in the second pair viewing a motion detection field of view through the window, and electrically receiving the first signal output and the second signal output and providing an output indication of crossing the field of view by an object having a temperature different from the ambient in the field of view.

Preferably, providing an output indication is responsive to detection of crossing the field of view by an object at an angular velocity of between 1 and 2 degrees per second. Preferably, the method also includes disregarding repeated crossing of the field of view in opposite directions by an object at an angular velocity less than 0.5 degrees per second.

In accordance with a preferred embodiment of the present invention, the method also includes providing an output indication of direction of crossing the field of view by an object having a temperature different from the ambient in the field of view.

Preferably, the method also includes providing an alarm output indication in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view in a first general direction and not in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view in a second general direction opposite to the first general direction.

Preferably, the method also includes providing a first output indication in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view in a first general direction and a second output indication in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view in a second general direction opposite to the first general direction.

Preferably, the method also includes providing an alarm output indication in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view and not in respect of a stationary object having a temperature different from the ambient in the field of view.

Preferably, the method also includes providing an alarm output indication in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view and not in respect of a stationary object outside of the field of view having a temperature different from the ambient in the field of view.

Preferably, the method also includes providing an alarm output indication in respect of crossing the field of view by an object having a temperature different from the ambient in the field of view and not in respect of repeated back-and-forth crossings of the field of view by an object having a temperature different from the ambient in the field of view.

Preferably, the method also includes providing an alarm output indication in respect of crossing the field of view by a human and not in respect of crossing the field of view by a pet.

There is further provided in accordance with yet another preferred embodiment of the present invention a pyro-electric sensor including at least first and second pairs of pyro-electric elements, electrical interconnections between the pyro-electric elements in the first pair of pyro-electric elements, providing a first signal output and local temperature compensation for the two pyro-electric elements in the first pair, electrical interconnections between the pyro-electric elements in the second pair of pyro-electric elements, providing a second signal output and local temperature compensation for the two pyro-electric elements in the second pair, wherein the local temperature compensation for the two pyro-electric elements in the first pair is independent of the local temperature compensation for the two pyro-electric elements in the second pair, and a housing enclosing the at least first and second pairs of pyro-electric elements and defining a window, only one of the pyro-electric elements in the first pair and only one of the pyro-electric elements in the second pair viewing a motion detection field of view through the window.

There is yet further provided in accordance with still another preferred embodiment of the present invention a method for pyro-electric sensing, the method including electrically interconnecting between the pyro-electric elements of a first pair of pyro-electric elements, providing a first signal output and local temperature compensation for the two pyro-electric elements in the first pair, electrically interconnecting between the pyro-electric elements of a second pair of pyro-electric elements, providing a second signal output and local temperature compensation for the two pyro-electric elements in the second pair, wherein the local temperature compensation for the two pyro-electric elements in the first pair is independent of the local temperature compensation for the two pyro-electric elements in the second pair, and enclosing the at least first and second pairs of pyro-electric elements and defining a window, only one of the pyro-electric elements in the first pair and only one of the pyro-electric elements in the second pair viewing a motion detection field of view through the window.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings in which:

FIG. **1** is a simplified illustration of the operation of a motion detection system constructed and operative in accordance with a preferred embodiment of the present invention showing how the system differentiates between crossings in opposite directions;

FIG. **2** is a simplified illustration of operation of the motion detection system of FIG. **1**, showing how the system eliminates false alarms due to thermal effects within the system field of view;

FIG. **3** is a simplified illustration of operation of the motion detection system of FIG. **1**, showing how the system eliminates false alarms due to thermal effects outside the system field of view;

FIG. **4** is a simplified illustration of operation of the motion detection system of FIG. **1**, showing how the system eliminates false alarms due to repeated back-and-forth single beam crossings;

FIG. **5** is a simplified illustration of operation of the motion detection system of FIG. **1**, showing how the system eliminates false alarms due to repeated back-and-forth crossings;

FIGS. **6**A and **6**B are simplified illustrations of operation of the motion detection system, showing how the system differentiates between a crossing of a human and a crossing of a pet;

FIG. **7** is a simplified illustration of operation of the motion detection system of FIG. **1**, showing how the system detects a crossing in a single direction at a high angular velocity; and

FIGS. **8**A and **8**B are simplified pictorial and sectional illustrations of two alternative arrangements of pyro-electric elements useful in the system of FIGS. **1**-**7**.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Reference is now made to FIG. **1**, which is a simplified illustration of the operation of a motion detection system constructed and operative in accordance with a preferred embodiment of the present invention showing how the system differentiates between crossings in opposite directions.

As seen in FIG. **1**, there is provided a motion detection system **100** including at least one detector **102** including focusing optics (not shown) which focus infra-red radiation from fields of view onto a sensor **104**. In accordance with a preferred embodiment of the present invention, the sensor **104** includes a housing **106** defining a window **108**.

Disposed within housing **106** are first and second pairs of pyro-electric elements **110**, which are respectively designated L+ & L− and R+ & R−. Typically, all of the pyro-electric elements **110** are identical and their L and R designations indicate only that they are on respective left and right sides of sensor **104** as seen in enlargement A in FIG. **1**.

In accordance with a preferred embodiment of the present invention, the pyro-electric elements **110** of each pair are electrically connected with opposite polarity therebetween, such that the electrically connected first pair of pyro-electric elements **110** (L+ & L−) provides a first summed signal output and local temperature compensation therefor. Similarly, the electrically connected second pair of pyro-electric elements **110** (R+ & R−) provides a second summed signal output and local temperature compensation therefor.

It is a particular feature of an embodiment of the present invention that the local temperature compensation for the two pyro-electric elements **110** in the first pair (L+ & L−) is independent of the local temperature compensation for the two pyro-electric elements **110** in said second pair (R+ & R−).

It is an important feature of an embodiment of the present invention that the housing **106** is constructed such that only one of the pyro-electric elements **110** in the first pair and only one of the pyro-electric elements in the second pair view a motion detection field of view through window **108**. Housing **106** prevents infra-red radiation from the motion detection field of view in the wavelength bands of interest from reaching the other one of the pyro-electric elements **110** in each pair, here L− & R−. The pyro-electric elements **110** which are thus blocked from viewing the motion detection field of view by housing **106** provide local temperature compensation for the respective pyro-electric elements, here L+ & R+, which are within window **108** and are paired therewith.

In accordance with a preferred embodiment of the present invention a signal processor electrically receives the first and second summed signal outputs and provides an output indication of crossing of the motion detection field of view by an object having a temperature different from the ambient in the motion detection field of view. Preferably, the signal processor is operative to disregard repeated crossing of the field of view in opposite directions by an object at an angular velocity less than 0.5 degrees per second.

In a simplified circuit diagram designated B in FIG. **1**, it is seen that pyro-electric elements L+ & L− are electrically connected in series across a resistance **112** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **114** to alarm logic **116**, which includes the signal processor mentioned above. Similarly, it is seen that pyro-electric elements R+ & R− are electrically connected in series across a resistance **122** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **124** to alarm logic **116**.

It is further seen that the motion of a person moving from left to right as seen in enlargement C in FIG. **1**, produces summed L and R outputs, which comprise an L peak and an R peak, respectively. As clearly shown, the L peak leads the R peak by a time interval denoted as Delta T, and therefore indicates movement of a person from left to right in the sense of enlargement C.

Similarly, it is further seen that the motion of a person moving from right to left as seen in enlargement C in FIG. **1**, also produces summed L and R outputs, which comprise an L peak and an R peak, respectively. As clearly shown, the R peak leads the L peak by a time interval denoted as Delta T, and therefore indicates movement of a person from right to left in the sense of enlargement C.

Alarm logic **116** is operative to ascertain that at least a minimum time difference Delta T between the R and L peaks is present and to distinguish between signals which indicate right to left motion and left to right motion.

Reference is now made to FIG. **2**, which is a simplified illustration of operation of the motion detection system of FIG. **1**, showing how the system eliminates false alarms due to thermal effects within the system field of view.

As seen in FIG. **2** and as described hereinabove with regard to FIG. **1**, motion detection system **100** comprises at least one detector **102** which focusing optics (not shown) focus infra-red radiation from fields of view onto sensor **104**. In accordance with a preferred embodiment of the present invention, sensor **104** includes a housing **106** defining a window **108**.

Disposed within housing **106** are first and second pairs of pyro-electric elements **110**, which are respectively designated L+ & L− and R+ & R−. Typically, all of the pyro-electric elements **110** are identical and their L and R designations indicate only that they are on respective left and right sides of sensor **104** as seen in enlargement A in FIG. **2**.

In accordance with a preferred embodiment of the present invention, the pyro-electric elements **110** of each pair are electrically connected with opposite polarity therebetween, such that the electrically connected first pair of pyro-electric elements **110** (L+ & L−) provides a first summed signal output and local temperature compensation therefor. Similarly, the electrically connected second pair of pyro-electric elements **110** (R+ & R−) provides a second summed signal output and local temperature compensation therefor.

It is a particular feature of an embodiment of the present invention that the local temperature compensation for the two pyro-electric elements **110** in the first pair (L+ & L−) is independent of the local temperature compensation for the two pyro-electric elements **110** in said second pair (R+ & R−).

It is an important feature of this embodiment of the present invention that the housing **106** is constructed such that only one of the pyro-electric elements **110** in the first pair and only one of the pyro-electric elements in the second pair view a motion detection field of view through window **108**. Housing **106** prevents infra-red radiation from the motion detection field of view in the wavelength bands of interest from reaching the other one of the pyro-electric elements **110** in each pair, here L− & R−. The pyro-electric elements **110** which are thus blocked from viewing the motion detection field of view by housing **106** provide local temperature compensation for the respective pyro-electric elements, here L+ & R+, which are within window **108** and are paired therewith.

In accordance with a preferred embodiment of the present invention a signal processor electrically receives the first and second summed signal outputs and provides an output indication of crossing of the motion detection field of view by an object having a temperature different from the ambient in the motion detection field of view.

In a simplified circuit diagram designated B in FIG. **2**, it is seen that pyro-electric elements L+ & L− are electrically connected in series across a resistance **112** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **114** to alarm logic **116**, which includes the signal processor mentioned above. Similarly, it is seen that pyro-electric elements R+ & R− are electrically connected in series across a resistance **122** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **124** to alarm logic **116**.

As seen in enlargement C of FIG. **2**, heat radiated from a heating element, such as a radiator, located within the field of view of pyro-electric elements L+ & R+ within window **108**, is detected by pyro-electric elements **110** L+ & R+, while not being detected by pyro-electric elements **110** L− & R−.

As further shown in FIG. **2**, system **100** produces similar summed L and R outputs over time, the summed L and R outputs generally corresponding to the intensity of heat radiated from the radiator over time.

As clearly shown in enlargement C, the L peaks generally correspond to the R peaks, and the time difference, delta T, between each of the L peaks and a corresponding R peak is negligible. Therefore, alarm logic **116** ascertains that there is no right to left motion or left to right motion opposite detector **102**, and that the similar summed L and R outputs merely indicate the presence of a stationary thermal effect.

Reference is now made to FIG. **3**, which is a simplified illustration of operation of the motion detection system of FIG. **1**, showing how the system eliminates false alarms due to thermal effects outside the system field of view.

As seen in FIG. **3** and as described hereinabove with regard to FIG. **1**, motion detection system **100** comprises at least one detector **102** which focusing optics (not shown) focus infra-red radiation from fields of view onto sensor **104**. In accordance with a preferred embodiment of the present invention, sensor **104** includes a housing **106** defining a window **108**.

Disposed within housing **106** are first and second pairs of pyro-electric elements **110**, which are respectively designated L+ & L− and R+ & R−. Typically, all of the pyro-electric elements **110** are identical and their L and R designations indicate only that they are on respective left and right sides of sensor **104** as seen in enlargement A in FIG. **3**.

In accordance with a preferred embodiment of the present invention, the pyro-electric elements **110** of each pair are electrically connected with opposite polarity therebetween, such that the electrically connected first pair of pyro-electric elements **110** (L+ & L−) provides a first summed signal output and local temperature compensation therefor. Similarly, the electrically connected second pair of pyro-electric elements **110** (R+ & R−) provides a second summed signal output and local temperature compensation therefor.

It is a particular feature of an embodiment of the present invention that the local temperature compensation for the two pyro-electric elements **110** in the first pair (L+ & L−) is independent of the local temperature compensation for the two pyro-electric elements **110** in said second pair (R+ & R−).

It is an important feature of this embodiment of the present invention that the housing **106** is constructed such that only one of the pyro-electric elements **110** in the first pair and only one of the pyro-electric elements in the second pair view a motion detection field of view through window **108**. Housing **106** prevents infra-red radiation from the motion detection field of view in the wavelength bands of interest from reaching the other one of the pyro-electric elements **110** in each pair, here L− & R−. The pyro-electric elements **110** which are thus blocked from viewing the motion detection field of view by housing **106** provide local temperature compensation for the respective pyro-electric elements, here L+ & R+, which are within window **108** and are paired therewith.

In accordance with a preferred embodiment of the present invention a signal processor electrically receives the first and second summed signal outputs and provides an output indication of crossing of the motion detection field of view by an object having a temperature different from the ambient in the motion detection field of view.

In a simplified circuit diagram designated B in FIG. **3**, it is seen that pyro-electric elements L+ & L− are electrically connected in series across a resistance **112** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **114** to alarm logic **116**, which includes the signal processor mentioned above. Similarly, it is seen that pyro-electric elements R+ & R− are electrically connected in series across a resistance **122** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **124** to alarm logic **116**.

As shown in FIG. **3**, a hot water pipe **130** passes behind detector **102** in close proximity thereto, thereby not passing through the field of view of pyro-electric elements L+ & R+.

As further shown in FIG. **3**, it is seen that pyro-electric elements **110** L+ & R+ both generate signals which correspond to the detection of a periodic source of heat, such as heated water flowing through pipe **130**. Accordingly, as described hereinabove, pyro-electric elements L− & R−, which also detect the periodic source of heat radiating from pipe **130**, provide local provide local temperature compensation for corresponding pyro-electric elements L+ & R+, which are paired therewith. As a result of the compensation provided by pyro-electric elements L− & R−, the summed L and R outputs over time are generally null, which corresponds to the field of view of pyro-electric elements L+ & R+ being void of any motion, thereby eliminating a potential false alarms due to thermal effects outside the system field of view.

Reference is now made to FIG. **4**, which is a simplified illustration of operation of the motion detection system of FIG. **1**, showing how the system eliminates false alarms due to repeated back-and-forth single beam crossings.

As seen in FIG. **4** and as described hereinabove with regard to FIG. **1**, motion detection system **100** comprises at least one detector **102** which focusing optics (not shown) focus infra-red radiation from fields of view onto sensor **104**. In accordance with a preferred embodiment of the present invention, sensor **104** includes a housing **106** defining a window **108**.

Disposed within housing **106** are first and second pairs of pyro-electric elements **110**, which are respectively designated L+ & L− and R+ & R−. Typically, all of the pyro-electric elements **110** are identical and their L and R designations indicate only that they are on respective left and right sides of sensor **104** as seen in enlargement A in FIG. **4**.

In accordance with a preferred embodiment of the present invention, the pyro-electric elements **110** of each pair are electrically connected with opposite polarity therebetween, such that the electrically connected first pair of pyro-electric elements **110** (L+ & L−) provides a first summed signal output and local temperature compensation therefor. Similarly, the electrically connected second pair of pyro-electric elements **110** (R+ & R−) provides a second summed signal output and local temperature compensation therefor.

It is a particular feature of an embodiment of the present invention that the local temperature compensation for the two pyro-electric elements **110** in the first pair (L+ & L−) is independent of the local temperature compensation for the two pyro-electric elements **110** in said second pair (R+ & R−).

It is an important feature of this embodiment of the present invention that the housing **106** is constructed such that only one of the pyro-electric elements **110** in the first pair and only one of the pyro-electric elements in the second pair view a motion detection field of view through window **108**. Housing **106** prevents infra-red radiation from the motion detection field of view in the wavelength bands of interest from reaching the other one of the pyro-electric elements **110** in each pair, here L− & R−. The pyro-electric elements **110** which are thus blocked from viewing the motion detection field of view by housing **106** provide local temperature compensation for the respective pyro-electric elements, here L+ & R+, which are within window **108** and are paired therewith.

In accordance with a preferred embodiment of the present invention a signal processor electrically receives the first and second summed signal outputs and provides an output indication of crossing of the motion detection field of view by an object having a temperature different from the ambient in the motion detection field of view.

In a simplified circuit diagram designated B in FIG. **4**, it is seen that pyro-electric elements L+ & L− are electrically connected in series across a resistance **112** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **114** to alarm logic **116**, which includes the signal processor mentioned above. Similarly, it is seen that pyro-electric elements R+ & R− are electrically connected in series across a resistance **122** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **124** to alarm logic **116**.

As seen in enlargement C of FIG. **4**, a plant **132** is located in the field of view of pyro-electric element L+, whereby the leaves of plant **132** follow a back-and-forth motion through the field of view of pyro-electric element L+.

As further shown in FIG. **4**, system **100** produces summed L and R outputs over time. The summed L output comprises several peaks and is larger than a predefined threshold Th, thereby corresponding to motion of the leaves of plant **132** through the field of view of pyro-electric element L+ over time. Contrarily, the summed R output is lower than the predefined threshold Th, thereby corresponding to an empty field of view of pyro-electric element R+. Therefore, alarm logic **116** ascertains that there is no right to left motion or left to right motion opposite detector **102**, and that the summed L output merely indicates the presence of an object which follows a repeated back-and-forth single beam crossing within the field of view of pyro-electric element L+.

Reference is now made to FIG. **5** which is a simplified illustration of operation of the motion detection system of FIG. **1**, showing how the system eliminates false alarms due to repeated back-and-forth crossings.

As seen in FIG. **5** and as described hereinabove with regard to FIG. **1**, motion detection system **100** comprises at least one detector **102** which focusing optics (not shown) focus infra-red radiation from fields of view onto sensor **104**. In accordance with a preferred embodiment of the present invention, sensor **104** includes a housing **106** defining a window **108**.

Disposed within housing **106** are first and second pairs of pyro-electric elements **110**, which are respectively designated L+ & L− and R+ & R−. Typically, all of the pyro-electric elements **110** are identical and their L and R designations indicate only that they are on respective left and right sides of sensor **104** as seen in enlargement A in FIG. **5**.

In accordance with a preferred embodiment of the present invention, the pyro-electric elements **110** of each pair are electrically connected with opposite polarity therebetween, such that the electrically connected first pair of pyro-electric elements **110** (L+ & L−) provides a first summed signal output and local temperature compensation therefor. Similarly, the electrically connected second pair of pyro-electric elements **110** (R+ & R−) provides a second summed signal output and local temperature compensation therefor.

It is a particular feature of an embodiment of the present invention that the local temperature compensation for the two pyro-electric elements **110** in the first pair (L+ & L−) is independent of the local temperature compensation for the two pyro-electric elements **110** in said second pair (R+ & R−).

It is an important feature of this embodiment of the present invention that the housing **106** is constructed such that only one of the pyro-electric elements **110** in the first pair and only one of the pyro-electric elements in the second pair view a motion detection field of view through window **108**. Housing **106** prevents infra-red radiation from the motion detection field of view in the wavelength bands of interest from reaching the other one of the pyro-electric elements **110** in each pair, here L− & R−. The pyro-electric elements **110** which are thus blocked from viewing the motion detection field of view by housing **106** provide local temperature compensation for the respective pyro-electric elements, here L+ & R+, which are within window **108** and are paired therewith.

In accordance with a preferred embodiment of the present invention a signal processor electrically receives the first and second summed signal outputs and provides an output indication of crossing of the motion detection field of view by an object having a temperature different from the ambient in the motion detection field of view.

In a simplified circuit diagram designated B in FIG. **5**, it is seen that pyro-electric elements L+ & L− are electrically connected in series across a resistance **112** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **114** to alarm logic **116**, which includes the signal processor mentioned above. Similarly, it is seen that pyro-electric elements R+ & R− are electrically connected in series across a resistance **122** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **124** to alarm logic **116**.

As seen in enlargement C of FIG. **5**, a plant **134** is located in the motion detection field of view of window **108**, partly in the field of view of pyro-electric element L+ and partly in the field of view of pyro-electric element R+, whereby the leaves of plant **134** alternately follow a back-and-forth motion through both the field of view of pyro-electric element L+ and of pyro-electric element R+.

As further shown in FIG. **5**, system **100** produces summed L and R outputs over time. The summed L output corresponds to the motion of the leaves of plant **134** through the field of view of pyro-electric element L+ over time, and the summed R output corresponds to the motion of the leaves of plant **134** through the field of view of pyro-electric element R+ over time. As clearly shown, the L peak initially leads the R peak, and thereafter lags behind the R peak, thereby leading alarm logic **116** to ascertain that the plant initially follows a left to right movement and then reverts to a right to left movement. Alarm logic **116** therefore eliminates a potential false alarm due to repeated back-and-forth crossings of the plant.

Reference is now made to FIGS. **6**A and **6**B, which are simplified illustrations of operation of the motion detection system, showing how the system differentiates between a crossing of a human and a crossing of a pet.

As seen in FIGS. **6**A and **6**B and as described hereinabove with regard to FIG. **1**, motion detection system **100** comprises at least one detector **102** which focusing optics (not shown) focus infra-red radiation from fields of view onto sensor **104**. In accordance with a preferred embodiment of the present invention, sensor **104** includes a housing **106** defining a window **108**.

Disposed within housing **106** are first and second pairs of pyro-electric elements **110**, which are respectively designated T+ & T− and B+ & B−. Typically, all of the pyro-electric elements **110** are identical and their T and B designations indicate only that they are on respective top and bottom sides of sensor **104** as seen in enlargement A in FIGS. **6**A and **6**B.

In accordance with a preferred embodiment of the present invention, the pyro-electric elements **110** of each pair are electrically connected with opposite polarity therebetween, such that the electrically connected first pair of pyro-electric elements **110** (T+ & T−) provides a first summed signal output and local temperature compensation therefor. Similarly, the electrically connected second pair of pyro-electric elements **110** (B+ & B−) provides a second summed signal output and local temperature compensation therefor.

It is a particular feature of an embodiment of the present invention that the local temperature compensation for the two pyro-electric elements **110** in the first pair (T+ & T−) is independent of the local temperature compensation for the two pyro-electric elements **110** in said second pair (B+ & B−).

It is an important feature of this embodiment of the present invention that the housing **106** is constructed such that only one of the pyro-electric elements **110** in the first pair and only one of the pyro-electric elements in the second pair view a motion detection field of view through window **108**. Housing **106** prevents infra-red radiation from the motion detection field of view in the wavelength bands of interest from reaching the other one of the pyro-electric elements **110** in each pair, here T− & B−. The pyro-electric elements **110** which are thus blocked from viewing the motion detection field of view by housing **106** provide local temperature compensation for the respective pyro-electric elements, here T+ & B+, which are within window **108** and are paired therewith.

In accordance with a preferred embodiment of the present invention a signal processor electrically receives the first and second summed signal outputs and provides an output indication of crossing of the motion detection field of view by an object having a temperature different from the ambient in the motion detection field of view.

In a simplified circuit diagram designated B in FIGS. **6**A & **6**B, it is seen that pyro-electric elements T+ & T− are electrically connected in series across a resistance **112** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **114** to alarm logic **116**, which includes the signal processor mentioned above. Similarly, it is seen that pyro-electric elements B+ & B− are electrically connected in series across a resistance **122** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **124** to alarm logic **116**.

As seen in enlargement C of FIG. **6**A, a person walks across the field of view of detector **102**, thereby crossing the field of view of pyro-electric element T+ and the field of view of pyro-electric element B+.

As further shown in FIG. **6**A, system **100** produces summed T and B outputs over time. The summed T output corresponds to the motion of the person through the field of view of pyro-electric element T+ over time, and the summed B output corresponds to the motion of the person through the field of view of pyro-electric element B+ over time. As clearly shown, the T output and the B output both peak at the same time, corresponding to the simultaneously crossing of a relatively tall object, such as a person, through the fields of view of pyro-electric elements T+ and B+.

Turning now to FIG. **6**B, it is shown that a pet, such as a dog walks across the field of view of detector **102**, thereby crossing the field of view of the lower pyro-electric element B+ while not crossing the field of view of the upper pyro-electric element T+.

As further shown in FIG. **6**B, system **100** produces summed T and B outputs over time. The summed T output corresponds to motion through the field of view of pyro-electric element T+ over time, while the summed T output corresponds to motion through the field of view of pyro-electric element B+ over time. As clearly shown, the T output is generally null while the B output comprises a peak which corresponds to an object crossing the field of view of pyro-electric element B+. Crossing of the field of view of pyro-electric element B+ while not crossing the field of view of pyro-electric element T+ corresponds to the crossing of a relatively short object, such as a dog, through the field of view of detector **102**.

Reference is now made to FIG. **7**, which is a simplified illustration of operation of the motion detection system of FIG. **1**, showing how the system detects a crossing in a single direction at a high angular velocity.

As seen in FIG. **7** and as described hereinabove with regard to FIG. **1**, motion detection system **100** comprises at least one detector **102** which focusing optics (not shown) focus infra-red radiation from fields of view onto sensor **104**. In accordance with a preferred embodiment of the present invention, sensor **104** includes a housing **106** defining a window **108**.

Disposed within housing **106** are first and second pairs of pyro-electric elements **110**, which are respectively designated L+ & L− and R+ & R−. Typically, all of the pyro-electric elements **110** are identical and their L and R designations indicate only that they are on respective left and right sides of sensor **104** as seen in enlargement A in FIG. **7**.

In accordance with a preferred embodiment of the present invention, the pyro-electric elements **110** of each pair are electrically connected with opposite polarity therebetween, such that the electrically connected first pair of pyro-electric elements **110** (L+ & L−) provides a first summed signal output and local temperature compensation therefor. Similarly, the electrically connected second pair of pyro-electric elements **110** (R+ & R−) provides a second summed signal output and local temperature compensation therefor.

It is a particular feature of an embodiment of the present invention that the local temperature compensation for the two pyro-electric elements **110** in the first pair (L+ & L−) is independent of the local temperature compensation for the two pyro-electric elements **110** in said second pair (R+ & R−).

It is an important feature of this embodiment of the present invention that the housing **106** is constructed such that only one of the pyro-electric elements **110** in the first pair and only one of the pyro-electric elements in the second pair view a motion detection field of view through window **108**. Housing **106** prevents infra-red radiation from the motion detection field of view in the wavelength bands of interest from reaching the other one of the pyro-electric elements **110** in each pair, here L− & R−. The pyro-electric elements **110** which are thus blocked from viewing the motion detection field of view by housing **106** provide local temperature compensation for the respective pyro-electric elements, here L+ & R+, which are within window **108** and are paired therewith.

In accordance with a preferred embodiment of the present invention a signal processor electrically receives the first and second summed signal outputs and provides an output indication of crossing of the motion detection field of view by an object having a temperature different from the ambient in the motion detection field of view. Preferably, the signal processor is operative to provide detection of crossing the field of view by an object at an angular velocity of between 1 and 2 degrees per second.

In a simplified circuit diagram designated B in FIG. **7**, it is seen that pyro-electric elements L+ & L− are electrically connected in series across a resistance **112** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **114** to alarm logic **116**, which includes the signal processor mentioned above. Similarly, it is seen that pyro-electric elements R+ & R− are electrically connected in series across a resistance **122** and together generate a signal which is the sum of their respective outputs and is supplied via a FET **124** to alarm logic **116**.

It is further seen that the motion of a person moving from left to right as seen in enlargement C in FIG. **7**, produces summed L and R outputs, which respectively comprise an L peak and an R peak. As clearly shown, the L peak leads the R peak by a time interval indicated as Delta T, and therefore indicates movement of a person from left to right in the sense of enlargement C.

Alarm logic **116** is operative to ascertain that the time difference Delta T is relatively short, and therefore corresponds to a crossing in a single direction at a high angular velocity.

Reference is now made to FIGS. **8**A and **8**B, which are simplified pictorial and sectional illustrations of two alternative arrangements of pyro-electric elements useful in the system of FIGS. **1**-**7**.

As seen in FIG. **8**A and as described hereinabove with regard to FIG. **1**, the motion detection system comprises at least one detector **102** comprising focusing optics (not shown) which focus infra-red radiation from fields of view onto sensor **104**. In accordance with a preferred embodiment of the present invention, sensor **104** includes a housing **106** defining a window **108**.

Mounted on a forward side of a mounting element **140** within housing **106** are first and second pairs of pyro-electric elements **110**, which are respectively designated L+ & L− and R+ & R−. Typically, all of the pyro-electric elements **110** are identical and their L and R designations indicate only that they are on respective left and right sides of sensor **104**.

As shown in FIG. **8**A, housing **106** is constructed such that only one of the pyro-electric elements **110** in the first pair, here L+, and only one of the pyro-electric elements in the second pair, here R−, view a motion detection field of view through window **108**. Housing **106** prevents infra-red radiation from the motion detection field of view in the wavelength bands of interest from reaching the other one of the pyro-electric elements **110** in each pair, here L− & R+. The pyro-electric elements **110** which are thus blocked from viewing the motion detection field of view by housing **106** provide local temperature compensation for the respective pyro-electric elements, here L+ & R−, which are within window **108** and are paired therewith.

Alternatively, as shown in FIG. **8**B, one of the pyro-electric elements **110** in the first pair, here L+, and one of the pyro-electric elements in the second pair, here R+, are mounted on a forward side of mounting element **140** and view a motion detection field of view through window **108**. The other one of the pyro-electric elements **110** in each pair, here L− & R−, are mounted on a rearward side of mounting element **140**, generally opposite pyro-electric elements L+ & R+. The pyro-electric elements **110** which are thus blocked from viewing the motion detection field of view by housing **106** provide local temperature compensation for the respective pyro-electric elements, here L+ & R−, which are within window **108** and are paired therewith.

It will be appreciated by persons skilled in the art that the present invention is not limited by what has been particularly shown and described hereinabove. Rather the scope of the present invention includes both combinations and subcombinations of the various features described hereinabove as well as modifications thereof which would occur to persons skilled in the art upon reading the foregoing description and which are not in the prior art.

The invention claimed is:

1. A motion detector system comprising:

at least first and second pairs of pyro-electric elements, said first pair of pyro-electric elements including first and second pyro-electric elements, said second pair of pyro-electric elements including third and fourth pyro-electric elements;

a housing enclosing said at least first and second pairs of pyro-electric elements and defining a window, only said first and said third pyro-electric elements viewing a motion detection field of view through said window, said second and fourth pyro-electric elements not viewing said motion detection field of view through said window;

said first and second pyro-electric elements in said first pair of pyro-electric elements being electrically connected with opposite polarity therebetween, thereby subtracting the output of said second pyro-electric element from the output of said first pyro-electric element and thereby cancelling out temperature changes taking place within said housing, which are simultaneously sensed by said first and second pyro-electric elements, thereby providing a first summed signal output representing activity at a first portion of said motion detection field of view and a first local temperature compensation therefor;

said third and fourth pyro-electric elements in said second pair of pyro-electric elements being electrically connected with opposite polarity therebetween, thereby subtracting the output of said fourth pyro-electric element from the output of said third pyro-electric element and thereby cancelling out temperature changes taking place within said housing, which are simultaneously sensed by said third and fourth pyro-electric elements, thereby providing a second summed signal output representing activity at a second portion of said motion detection field of view and a second local temperature compensation therefor, which second portion is different from said first portion of said motion detection field of view, said first local temperature compensation being independent of said second local temperature compensation; and

a signal processor electrically receiving said first output and said second output and providing an output indication of crossing said motion detection field of view in a given direction by an object having a temperature different from the ambient in said motion detection field of view.

2. A motion detector system according to claim **1** and wherein said signal processor is operative to provide detection of crossing said field of view by an object at an angular velocity of between 1 and 2 degrees per second.

3. A motion detection system according to claim **1** and wherein said signal processor is operative to disregard repeated crossing of said field of view in opposite directions by an object at an angular velocity less than 0.5 degrees per second.

4. A motion detection system according to claim **1** and wherein said signal processor provides an output indication of direction of crossing said field of view by an object having a temperature different from the ambient in said field of view.

5. A motion detection system according to claim **4** and wherein said signal processor provides an alarm output indication in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view in a first general direction and not in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view in a second general direction opposite to said first general direction.

6. A motion detection system according to claim **4** and wherein said signal processor provides a first output indication in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view in a first general direction and a second output indication in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view in a second general direction opposite to said first general direction.

7. A motion detection system according to claim **4** and wherein said signal processor provides an alarm output indication in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view and not in respect of a stationary object having a temperature different from the ambient in said field of view.

8. A motion detection system according to claim 4 and wherein said signal processor provides an alarm output indication in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view and not in respect of a stationary object outside of said field of view having a temperature different from the ambient in said field of view.

9. A motion detection system according to claim 4 and wherein said signal processor provides an alarm output indication in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view and not in respect of repeated back-and-forth crossings of said field of view by an object having a temperature different from the ambient in said field of view.

10. A motion detection system according to claim 4 and wherein said signal processor provides an alarm output indication in respect of crossing said field of view by a human and not in respect of crossing said field of view by a pet.

11. A method for detecting motion, the method comprising:

enclosing at least first and second pairs of pyro-electric elements, said first pair of pyro-electric elements including first and second pyro-electric elements, said second pair of pyro-electric elements including third and fourth pyro-electric elements;

defining a window, only one of said pyro-electric elements in said first pair and only one of said pyro-electric elements in said second pair viewing a motion detection field of view through said window;

electrically interconnecting between outputs of said first and second pyro-electric elements in said first pair of pyro-electric elements with opposite polarity therebetween, thereby subtracting the output of said second pyro-electric element from the output of said first pyro-electric element and thereby cancelling out temperature changes taking place within said housing, which are simultaneously sensed by said first and second pyro-electric elements, thereby providing a first summed signal output representing activity at a first portion of said motion detection field of view and a first local temperature compensation therefor;

electrically interconnecting between outputs of said third and fourth pyro-electric elements in said second pair of pyro-electric elements with opposite polarity therebetween, thereby subtracting the output of said fourth pyro-electric element from the output of said third pyro-electric element and thereby cancelling out temperature changes taking place within said housing, which are simultaneously sensed by said third and fourth pyro-electric elements, and thereby providing a second summed signal output representing activity at a second portion of said motion detection field of view and a second local temperature compensation therefor, which second portion is different from said first portion of said motion detection field of view, said first local temperature compensation being independent of said second local temperature compensation; and

electrically receiving said first output and said second output and providing an output indication of crossing said motion detection field of view in a given direction by an object having a temperature different from the ambient in said motion detection field of view.

12. A method according to claim 11 and wherein said providing an output indication is responsive to detection of crossing said field of view by an object at an angular velocity of between 1 and 2 degrees per second.

13. A method according to claim 11 and also comprising disregarding repeated crossing of said field of view in opposite directions by an object at an angular velocity less than 0.5 degrees per second.

14. A method according to claim 11 and also comprising providing an output indication of direction of crossing said field of view by an object having a temperature different from the ambient in said field of view.

15. A method according to claim 14 and also comprising providing an alarm output indication in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view in a first general direction and not in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view in a second general direction opposite to said first general direction.

16. A method according to claim 14 and also comprising providing a first output indication in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view in a first general direction and a second output indication in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view in a second general direction opposite to said first general direction.

17. A method according to claim 14 and also comprising providing an alarm output indication in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view and not in respect of a stationary object having a temperature different from the ambient in said field of view.

18. A method according to claim 14 and also comprising providing an alarm output indication in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view and not in respect of a stationary object outside of said field of view having a temperature different from the ambient in said field of view.

19. A method according to claim 14 and also comprising providing an alarm output indication in respect of crossing said field of view by an object having a temperature different from the ambient in said field of view and not in respect of repeated back-and-forth crossings of said field of view by an object having a temperature different from the ambient in said field of view.

20. A method according to claim 14 and also comprising providing an alarm output indication in respect of crossing said field of view by a human and not in respect of crossing said field of view by a pet.

21. A pyro-electric sensor comprising:

at least first and second pairs of pyro-electric elements, said first pair of pyro-electric elements including first and second pyro-electric elements, said second pair of pyro-electric elements including third and fourth pyro-electric elements;

a housing enclosing said at least first and second pairs of pyro-electric elements and defining a window, only said first and said third pyro-electric elements viewing a motion detection field of view through said window, said second and fourth pyro-electric elements not viewing said motion detection field of view through said window;

said first and second-pyro-electric elements in said first pair of pyro-electric elements being electrically connected with opposite polarity therebetween, thereby subtracting the output of said second pyro-electric element from the output of said first pyro-electric element and thereby cancelling out temperature changes taking place within said housing, which are simultaneously sensed by said first and second pyro-electric elements, thereby providing a first summed signal output representing activity at a first portion of said motion detection field of view and a first local temperature compensation therefor; and

said third and fourth-pyro-electric elements in said second pair of pyro-electric elements being electrically connected with opposite polarity therebetween, thereby subtracting the output of said fourth pyro-electric element from the output of said third pyro-electric element and thereby cancelling out temperature changes taking place within said housing, which are simultaneously sensed by said third and fourth pyro-electric elements, thereby providing a second summed signal output representing activity at a second portion of said motion detection field of view and a second local temperature compensation therefor, which second portion is different from said first portion of said motion detection field of view, said first local temperature compensation being independent of said second local temperature compensation.

22. A method for pyro-electric sensing, the method comprising:

enclosing at least first and second pairs of pyro-electric elements, said first pair of pyro-electric elements including first and second pyro-electric elements, said second pair of pyro-electric elements including third and fourth pyro-electric elements;

defining a window, only one of said pyro-electric elements in said first pair and only one of said pyro-electric elements in said second pair viewing a motion detection field of view through said window;

electrically interconnecting between outputs of said first and second pyro-electric elements in said first pair of pyro-electric elements with opposite polarity therebetween, thereby subtracting the output of said second pyro-electric element from the output of said first pyro-electric element and thereby cancelling out temperature changes taking place within said housing, which are simultaneously sensed by said first and second pyro-electric elements, thereby providing a first summed signal output representing activity at a first portion of said motion detection field of view and a first local temperature compensation therefor;

electrically interconnecting between outputs of said third and fourth pyro-electric elements in said second pair of pyro-electric elements with opposite polarity therebetween, thereby subtracting the output of said fourth pyro-electric element from the output of said third pyro-electric element and thereby cancelling out temperature changes taking place within said housing, which are simultaneously sensed by said third and fourth pyro-electric elements, thereby providing a second summed signal output representing activity at a second portion of said motion detection field of view and a second local temperature compensation therefor, which second portion is different from said first portion of said motion detection field of view, said first local temperature compensation being independent of said second local temperature compensation.

23. A motion detector system comprising:

first and second pyro-electric elements, viewing a motion detection field of view;

at least a third pyro-electric element, not viewing said motion detection field of view;

a housing enclosing said first, second and third pyro-electric elements and defining a window, only said first and said second pyro-electric elements viewing said motion detection field of view through said window;

said first and at least third pyro-electric elements being electrically connected with opposite polarity therebetween, thereby subtracting the output of said at least third pyro-electric element from the output of said first pyro-electric element and thereby cancelling out temperature changes taking place within said housing, which are simultaneously sensed by said first and said at least third pyro-electric elements, thereby providing a first summed signal output representing activity at a first portion of said motion detection field of view and a first local temperature compensation therefor;

said second and at least third pyro-electric elements being electrically connected with opposite polarity therebetween, thereby subtracting the output of said at least third pyro-electric element from the output of said second pyro-electric element and thereby cancelling out temperature changes taking place within said housing, which are simultaneously sensed by said first and said at least third pyro-electric elements, thereby providing a second summed signal output representing activity at a second portion of said motion detection field of view and a second local temperature compensation therefor, said first local temperature compensation being independent of said second local temperature compensation; and

a signal processor electrically receiving said first output and said second output and providing an output indication of crossing said motion detection field of view by an object having a temperature different from the ambient in said motion detection field of view.

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